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BILINGUAL MEN BUT NOT WOMEN DISPLAY VERBAL MEMORY WEAKNESSES BUT NOT FIGURAL MEMORY DIFFERENCES COMPARED TO MONOLINGUALS

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Summary—Immediate and delayed (30 min) memory for routine verbal and figural tasks was determined for men and women who utilized only one or more than one language. The immediate and delayed memory of men who had been fluent in a language other than English, before 6 years of age, contained 20 to 50% less detail than men who were only fluent in English. This discrepancy was not observed for women. There were no consistent sex differences for memory scores for the figural tasks. Covariance for neither spatial nor digit span altered the group differences for verbal memory. These results support the hypothesis that the lower verbal fluency of men relative to women is reflective of a general weakness in language processing; the effect may be simply exacerbated when another language (English) is acquired after 6 years of age.

INTRODUCTION

Several studies have suggested that the acquisition of more than one language interferes with the execution of either one or both (Albert & Obler, 1978; Furtado & Webster, 1991). Our clinical neuropsychological assessments over the last decade have suggested that bilingual men recall about 20 to 40% less than monolingual men when both are tested in English, even though the bilingual men considered themselves proficient in both languages. This discrepancy is rarely seen in bilingual women.

During the same period the ratio of boys:girls (age >7 years) who have been referred for language or secondary behavioral problems subsequent to exposure to French Immersion programs has been about 10:1. However this gender difference may have been confounded by the factors that contributed to the referral for assessment. Overall, referrals for neurolinguistic issues appear to have a greater proportion of men relative to women for all ages.

In light of the known developmental discrepancy between males and females within the domain of verbal fluency (Kolb & Whishaw, 1990), we suspected that competitive deficits due to the acquisition of two languages would be evident for even normal men who were not being assessed for clinical difficulties. If the phenomenon were robust, we expected to observe comparable quantitative decrements in verbal but not in figural memory for men but not for women who first learned any language other than English. Because Laurentian University is an official French–English institution and the city of Sudbury is a rich mixture of many language traditions, we expected a sufficient sample of people to test the effect of multiple languages.

There were three major neuropsychological concepts from which we derived our hypothesis. First, Kimura (1987) has demonstrated that the spatial representations of language processing within the male adult left hemisphere is more posterior than in the normal female adult brain; these observations were considered significant in light of the presumed differential representations of different languages (Zatorre, 1989). Second, Norman Geschwind (Geschwind & Galaburda, 1985) suggested that the male hormone testosterone differentially delays the development of the left hemisphere and hence would restrict the upper limits of complex (linguistic) processing. Third, the enhanced electrical coherence between the hemispheres for normal women compared to men

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(Corsi-Cabrera, Herrera & Malvido, 1989) would increase the efficiency of linguistic processing for women by facilitating the involvement of both hemispheres.

METHOD

Subjects

A total of 58 men and 67 women served as *S*s; the mean and standard deviation for the ages were 27.3 and 8.1, respectively. This sample involved a complete consecutive sequence of people who volunteered for testing; the population was composed of 65% university students, 25% university staff and 10% community members.

Procedure

Each *S* was tested individually. Raw scores for the immediate and delayed (+30 min) memory for the two narratives (Verbal Memory A and B, respectively) and the 4 figures from the Wechsler Memory Scale were determined for each *S* (the *S*s were not told about the delayed memory task until it was presented). To facilitate comparison the total memory score for the first 2 figures (Figural Memory A) was calculated separately from the more complex figure (Figural Memory B). Scores for the Digit Span subtest from the WAIS-R and the Spatial Span, using the Corsi Block method, were also determined.

To determine language history, each person was asked to describe: (1) their first language, i.e. before age 6 (after Sussman, Franklin & Simon, 1982), (2) grade school language, (3) high school language, (4) the language in which they most frequently think and (5) the language in which they dream. If the answer for each of these questions was English, a 0 score was given; if the answer was another language, then a 1 was given. A dichotomous variable was calculated that indicated if the person had utilized only English (all 0s) or another language in at least one of the categories. The results are shown in Table 1. In addition, a total "other language" score was determined by adding these values (range 0 to 5).

*S*s were also assigned to one of three first language groups: 0, for English only *S*s; 1, for bilingual Francophone *S*s and 2, for *S*s who had learned any first language that was neither French nor English. These first languages were primarily Ukrainian, Italian, German, Finish, Urdu, Greek and Chinese. Similar variables were calculated for the primary grade school and high school language. Educational background was calculated according to the number of formal grades that had been achieved (1 through 13); years of undergraduate university (14 through 17), years of postgraduate training in M.A./M.Sc. programs (18 and 19) and achievement of a Ph.D./M.D. (20). All statistical analysis involved SPSSx software on a Vax 4000 computer.

RESULTS

The means and standard deviations for the verbal memory, pictorial memory, digit span and spatial span scores for men and women who engaged in a single language or more than one language are shown in Table 2. Means for ages and years of education are also presented. Two way analysis of variance (ANOVA) as a function of gender and language utilization (one vs more than one) demonstrated no significant differences (all Fs < 1.00) for either digit or spatial span. Although there were no significant differences in age between language utilization, the men in our

Table 1. Proportions of *S*s who utilized a primary language other than English during various developmental stages

	Men ($n = 58$)		Women ($n = 67$)	
Period	English	Other	English	Other
Preschool	47%	53%	70%	30%
Grade school	60%	40%	73%	27%
High school	59%	41%	80%	20%
Present thinking	60%	40%	78%	22%
During dreams	67%	33%	84%	16%

Table 2. Means and standard deviations of raw scores for immediate and delayed (30 min) verbal and figural memory, digit span, spatial span and age for either monolingual or bilingual men and women

	Men				Women			
Task	Uni		Bil		Uni		Bil	
Immed Verb A	12.7	3.6	10.9	2.9	14.0	3.2	13.2	3.0
Immed Verb B	10.5	3.7	7.6	3.5	9.1	3.3	9.0	3.4
Delay Verb A	12.0	3.6	9.8	3.2	12.3	3.2	11.6	3.2
Delay Verb B	10.1	3.9	6.5	3.3	8.5	3.2	8.1	3.6
Immed Pict A	6.7	1.4	6.8	0.9	7.1	0.8	7.3	0.7
Immed Pict B	4.4	1.5	4.6	1.3	4.4	1.4	4.2	1.6
Delay Pict A	6.7	1.3	6.6	1.0	7.0	0.8	7.0	0.8
Delay Pict B	4.2	1.6	4.1	1.5	3.8	1.7	3.9	1.7
Digit Span	7.8	0.9	7.2	1.1	7.3	0.9	7.4	1.2
Spatial Span	7.0	0.7	6.8	0.9	7.0	1.0	6.9	1.1
Other variables								
Age	28	6	29	10	24	4	26	8
Years educat	14.5	2.0	15.3	2.5	14.1	2.1	15.2	2.4

sample were older than the women [$F(1,119) = 4.25$, $P = 0.02$]. Chi-squared analyses between S source (student, staff, community member) and bilingual score (no, yes) indicated no statistically significant ($P > 0.05$) disproportions for either the men or the women.

Multivariate analysis of variance (MANOVA) for the immediate verbal memory as a function of sex, language and the two (repeated measure) stories indicated that people who utilized more than one language recalled fewer details [$F(1,121) = 7.26$, $P = 0.008$] than those who used only one; neither the gender main effect nor the sex by language interaction were statistically significant. Covariance for both age and digit span did not alter the strength of the significance for the language effect.

All Ss displayed better accuracy for the first story compared to the second story [$F(1,121) = 125.13$, $P < 0.001$]. The only statistically significant interaction occurred between sex and story [$F(1,121) = 7.01$, $P = 0.009$]. This was due primarily to the poorer memory of the men relative to the women for the first story only. *Post hoc* ANOVAs indicated that the sex difference existed for the first story [$F(1,121) = 7.00$, $P = 0.009$; $\eta = 0.30$] but not for the second story ($F < 1$). Covariance for both age and digit span before the ANOVA did not change the strength of the significance for either the first [$F(1,117) = 6.98$, $P = 0.008$; $\eta = 0.29$] or second story.

The poorer memory for the men and women who engaged in more than one language relative to those who utilized only one language was also noted when the recall occurred 30 min later [$F(1,121) = 11.10$, $P = 0.001$]; the effect was diminished [$F(1,118) = 6.15$, $P = 0.02$] but not eliminated when the shared variance associated with age and digit span was removed before the analysis was completed. However the significant [$F(1,121) = 5.34$, $P = 0.02$] gender by language interaction, which was due to the relatively poorer memory of the men who engaged in more than one language compared to the men who did not, was not affected by the covariance for age and digit span [$F(1,118) = 6.63$, $P = 0.01$]. Recall of the second story was significantly worse than the recall of the first story [$F(1,121) = 83.24$, $P < 0.001$].

There were no significant sex, language or sex by language effects for either immediate or delayed figural memory [$F(1,121) < 1.00$, $P > 0.05$]. All Ss scored lower on the second set of figures for both the immediate [$F(1,121) = 334.64$, $P < 0.001$] and delayed [$F(1,121) = 279.51$, $P < 0.001$] recall. The significant sex by repeated measure interactions (first vs second set of figures) for both the immediate ($F = 4.64$, $P = 0.03$) and the delayed ($F = 3.85$, $P = 0.05$) recall were due to the greater deficit in recall between the first and second set of figures for the women compared to the men.

In order to discern the degree of intrusiveness from a second language upon memory for verbal passages, correlations were completed for each separately between the memory measures and the language involvement scale (range 0 through 5). As the bilingual factor increased the scores for both the immediate and delayed memory for each story decreased (Table 3). Men scored significantly [$F(1,123) = 7.18$, $P = 0.008$] higher ($M = 2.1$, $SD = 2.1$) on this scale than did the women ($M = 1.2$, $SD = 1.7$).

Because of the specific effect of a second language upon the verbal memory for men, the mother

Table 3. Pearson correlation coefficients between intrusiveness of another language (other than English) and scores for verbal memory, pictorial memory, digit span and spatial span for men and women

Task	Men	Women
Immed Verb A	−0.30*	0.01
Immed Verb B	−0.44**	0.14
Dealy Verb A	−0.37**	0.00
Delay Verb B	−0.52**	0.09
Immed Pict A	0.12	0.14
Immed Pict B	0.11	−0.02
Delay Pict A	0.03	0.09
Delay Pict B	−0.01	0.05
Spacial Span	−0.16	−0.18
Digit Span	−0.28*	0.09

*$P < 0.05$; **$P < 0.01$.

tongue (language before age 6 years) for each male *S* was determined: 27 English (monolingual), 10 Francophone and 17 other (about 10 different language groups). The means and standard deviations for each measure of memory as a function of the three groups is shown in Table 4. There were no statistically significant differences between the groups for level of educational achievement [$F(2,51) = 0.74$, $P > 0.05$].

Statistically significant group differences were found for both stories and for both immediate and delayed memory (*F* values in Table 3). *Post hoc* analysis (Tukey $P < 0.05$) indicated that for story B in particular the monolingual men displayed higher memory scores (immediate and delayed) than either the francophone-bilingual or other-bilingual groups who did not differ significantly from each other.

Similar analyses were completed for the men as a function of primary grade school (English, French or Other) and high school (English, French or Other) language. There were no statistically significant group differences for any of the measures. To insure the specificity of the gender effect, repeated measure analyses of variance were completed for the immediate (story A and B) and delayed (story A and B) scores as a function of sex and preschool language.

The significant language by sex interactions [$F(2,112) = 5.47$; 5.32, $P < 0.01$, respectively for immediate and delayed memory] were still present and were due exclusively to the poorer performance of the men who had been exposed to another language relative to the women. There was a main effect for the language groups for delayed memory only [$F(1,112) = 5.56$, $P = 0.005$]; *post hoc* analysis indicated this effect was due primarily to the poorer memory scores for men and women whose other language had not been French.

DISCUSSION

We chose a population from a bilingual university setting rather than from exclusively university students in order to more effectively represent the local community. The results of this study clearly indicate that men who have been exposed to more than one language display poorer memory for narratives than either monolingual men or either monolingual or bilingual women. The effect was

Table 4. Means and standard deviations for the scores for various memory tasks for men as a function of language before the age of 6 years

	English		French		Other		
Task	M	SD	M	SD	M	SD	*F*
Immed Verb A	12.7a	3.6	11.0	2.6	10.0b	2.6	3.97
Immed Verb B	10.6a	2.7	6.4b	3.0	7.0b	3.2	8.48
Delay Verb A	11.9a	3.7	9.7b	2.3	9.2	3.2	3.90
Delay Verb B	10.0a	3.8	5.1b	2.0	6.1b	3.4	10.58
Immed Pict A	6.7	1.3	7.5	0.5	6.7	0.9	0.51
Immed Pict B	4.5	1.5	4.8	1.5	4.2	1.3	0.60
Delay Pict A	6.7	1.2	7.0	1.2	6.5	0.9	0.70
Delay Pict B	4.3	1.5	4.4	1.3	3.9	1.5	0.70
Spatial Span	7.0	0.7	7.1	0.7	6.6	1.0	0.15
Digit Span	7.8a	0.9	7.1	1.4	6.9b	0.9	5.82

$F > 3.50$, $P < 0.05$.

most evident for the second (and more difficult) story; men who first learned another language (<6 years of age) as children but who were tested in English could remember only about half the amount of detail as men whose only language had been English. The absence of significant differences between the verbal memory scores for men who were Francophone and whose first language had been other than French, indicates that the effect is not specific to the one language.

These results were not artifacts of limited digit or spatial (attention) span because covariance for these variables did not alter the strength of the language effect. The possibility of lower general intelligence within this population of bilingual men is not likely in light of the absence of group differences for figural memory. On the bases of their behavioral presentation during the test procedure, requirements for employment and similarity in the numbers of years of formal education, all of our *S*s should have been within the range of average intelligence.

The specific weaknesses that were displayed by bilingual men (French or other language) compared to bilingual women, monolingual women or monolingual men, supports the hypothesis that the capacity for linguistic processing is statistically lower in men than in women because of the differential suppression of left hemispheric development by testosterone (Galaburda, 1987; Geschwind & Galaburda, 1985). This delay (or differential organization) could contribute to the poorer verbal skills in boys compared to age-matched girls (Kolb & Whishaw, 1990). Residual quantitative deficits in adults would not become evident until the linguistic limit is exceeded; this would occur preferentially in settings that demanded more than one language, especially when high rates of information processing are required.

The significantly lower verbal fluency in men compared to women, that becomes evident within the first 5 years of life (Kolb & Whishaw, 1990), has been attributed to differential expressive skills between genders. Results of the present study suggest that the lower verbal fluency may reflect a more general relative deficit in linguistic processing; it can also be manifested as deficits for the details of verbal memories. The effect is normally not evident until interference is introduced by another language system.

If these results are generalizable, then men whose first language was not English but who now interact in English should remember about 20 to 50% less detail after a single presentation of a verbal narrative. This quantitative deficit would not necessarily be obvious during casual conversation because of its emphasis upon general themes and the significant "compensatory" contribution from the context of the discussion and the expectancies of the listener. The deficit might also be eliminated by the simple repetition and the redundancy of the narrative.

We did not test for creativity. General learning theory (especially those within the operant tradition), predicts that learning more than one response to the same stimulus enhances the probability of combining these responses and other related responses in novel sequences. It is possible that the deficits in verbal memory may reflect differences in strategies of learning. If this is correct, then the same men (with a history of more than one language) who displayed the poorer memory for specific details might also exhibit greater creativity. Stated alternatively, these men may be less able to reiterate the same sequence of verbal memories because of greater intrusiveness from equally adaptive processes.

Our results partially support the age-of-acquisition hypothesis (Albert & Obler, 1978; Galloway, 1982); the results indicate that the hypothesis is valid for men but not for women, at least in our sample. On the other hand, Furtado and Webster (1991) found no support for this hypothesis, although they demonstrated lateralized interference for bilingual *S*s when they read in English or translated from French into English. Their study tested language proficiency rather than memory and employed a stronger motor component; it could have more positively affected the men than the women and hence could have obscured the intrinsic sex differences.

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